

AUSTRALIAN FRESHWATER PHYTOPLANKTON.  
[PROTOCOCCOIDEÆ.]

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(Plates lvi.-lix.)

The bulk of the material, on which the following notes are based, has been gathered at intervals during the past ten years, from the suburbs of Sydney, and from the neighbourhood of Lismore on the Richmond River. A few records are included, however, from still earlier up-country gatherings at Collector, and from certain samples which have been received from places outside the State of New South Wales. The opportunity has been taken, also, of revising the nomenclature of some of the plankton-forms noted in "Plankton of the Sydney Water-Supply" (these Proceedings, 1913).

*Habitats.*—The term "plankton" has been taken in a wide sense to include material found floating in the water of river, lake, lagoon, and pond, or shaken out of weeds in some depth of water. The following list shows the character of the habitat of all the gatherings referred to in the notes. River: 26, 44, 63, 74, 80, 81, 90, 100, 115, 180, 182, 187, 188, 189, 191, 193, 195, 196, 269, 274, 276, 281. Lagoon: 17, 37, 50, 51, 71, 91, 92, 95, 97, 99, 108, 133, 136, 144, 145, 152, 155, 258, 259, 260, 263, 285, 286, 290, 298. Pond: \*3, 23, 45, 70, 77, 88, 124, 125,\* 138, 150,\* 156,\* 158,\* 172. Creek-pool: 112, 129, 130.

*New forms.*—One new genus is proposed, and descriptions are given of 61 forms of *Protococcoideæ*, which appear to be new, 18 being classed as species, 37 as variations, and 6 as forms.

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\* Gardeners' tank, in the Botanic Gardens, fed from the Sydney Water-Supply.

## VOLVOCAEÆ.

Genus CARTERIA Diesing.

CARTERIA MULTIFILIS (Fresen.) Dill, forma.

Cellulæ globosæ (formæ immaturæ subglobosæ, oblongæ, vel ovales) apicibus plerumque leviter deplanatis (interdum mediana papilla instructis) vel indentatis; membrana tenui, hyalina, vel dilute rufescente.

Cell. (sphæric.) diam. 22-26: (oval., oblong., vel subglob.) long. 24-25, lat. 22-23 $\mu$ .

Parramatta Park (97). (Pl. lvi., figs. 1-4).

*Cf.* Francé, *Der Algengatt. Carteria*, *Természetráji Füzetek*, xix., 1896, T. iii., f. 1-5, etc. Obtained in quantity from rain-water-pools in Parramatta Park, where it showed as a pale yellow cloud in the water. Francé found it in a somewhat similar habitat ("aus dem Wasser einer grossen Strassenlache"). I have hesitated, for long, to identify our specimens with the European type, as they do not seem to agree very well in general appearance with Francé's excellent, coloured figures. Apart from the finely developed chloroplasts and red spot of the Hungarian specimens, ours differ chiefly in the shape of the cell, and the indented or flattened apex, the latter usually furnished with a minute papilla (alt. ca. 1 $\mu$ ). When full-grown, the cell is spherical, but more or less irregular subglobose; oblong or oval forms are common. The membrane, at first hyaline (or very slightly coloured) and very thin, later becomes somewhat stouter, and pale brown in colour, without markings. Francé gives dimensions, long. 19-25, lat. 12-15 $\mu$ .

CARTERIA SCROBICULATA, n.sp. (Pl. lvi., f. 5-7).

Cellulæ, fronte visæ, circulatæ, subcirculatæ, vel oblongæ, ubique rotundatæ, apicibus levissime indentatis; a latere compressæ, membrana crassa, rufescente, dense scrobiculata.

Cell. long. 18-22, lat. 18-20 $\mu$ .

Guildford (45); Lismore (263, 290).

This form differs from all the other species of *Carteria*, of which I have any knowledge, in having a closely scrobiculate

membrane. The cells, in front view, are very similar to the form of *C. multifilis* described above, but slightly smaller. In side-view, however, they are seen to be not globular but compressed from front to back. The membrane is always pale brown, and, under pressure, splits with a vitreous fracture, like the lorica of *Trachelomonas*. The lorica in this species, though in a solid piece, often breaks into two halves by an almost straight line down the sides, simulating the two adherent valves of *Phacotus*. Pl. lix., f.18, shows the compressed shape of the cell, and the overlap of the sides at the apex.

Var. OVALIS, n.var. (Pl. lvi., f.8).

Forma ovalis, circa dimidio major. Cell. long. 30, lat. 24 $\mu$ .

Lismore (263).

CARTERIA AUSTRALIS, n.sp. (Pl. lvi., f.9).

Cellulæ oblongæ, fronte modice cuneata, postice late-rotundatæ; lateribus leviter arcuatis. Membrana crassa. Cytoplasma dilute viride, minute granulatum, chloroplastidibus nullis distinctis nec pyrenoidibus. Nucleus in media cellula globo cavo chlorophyllaceo circumcinctus. Flagella 4.

Cell. long. 30, lat. 17; glob. chlorophyll. diam. 8 $\mu$ .

Lismore (263).

The nearest published species to this form would seem to be *C. obtusa* Dill, which is described by Chodat (Alg. vertes, p.138) as "Cellules ellipsoïdes . . . chromatophore en cloche allongée . . . dimensions 25-30 $\mu$ ." I have not seen Dill's type-figure, but Francé (Algengatt. *Carteria* T. iii., f.16-18) gives figures of typical specimens, which do not at all agree with our form, either in outline or in the arrangement of the cell-contents. The cytoplasm is finely granular, without any distinct arrangement, pyrenoid absent. The nucleus occupies the centre of the cell, surrounded by a hollow sphere of darker-coloured chlorophyll. From all sides, the appearance is the same.

Var. OVATA, n.var. (Pl. lvi., f.10).

Cellulæ ovatæ, fronte obtusæ, postice late-rotundatæ; ceteris ut in f. typica. Cell. long. 24, lat. 18 $\mu$ . Lismore (263).

Compare *Carteria Fritschii* Takeda, Ann. Bot. xxx., 1916, p.370.

## Genus CHLAMYDOMONAS Ehr.

## CHLAMYDOMONAS GLÆOCYSTIFORMIS Dill.

Cell. long. 20-21, lat. 17-21; corp. long. 13-16, lat. 8-10 $\mu$ .

Botanic Gardens (125). (Pl. lvi., f.11).

Cell. long. 14-18, lat. 12-15; corp. long. 8-10, lat. 7-8 $\mu$ .

Lismore (263). (Pl. lvi., f.12).

*Cf.* Dill, Gatt. Chlamyd., p.18, T. v., f.37, 38; Wille, Gatt. Chlamyd., Alg. Not. xi., p.143, T. iv., f.17; Bernard, Protococc. et Desm., p.163, f.307, 308. The last-named gives, membrane, 20-25  $\times$  17-20; inner cell, 16-17  $\times$  12-13 $\mu$ . Our Lismore specimens are considerably smaller.

## CHL. PISIFORMIS var. CYLINDRACEA Playf.

Cell. long. 21-26, lat. 12-15 $\mu$ .

Rookwood.

Var. ATTENUATA, n.var. (Pl. lvi., f.13).

Cellulæ a tergo attenuatæ; long. 20, lat. 12 $\mu$ .

Rookwood. Cum priori.

Var. GLÆOCYSTIFORMIS, n.var. (Pl. lvi., f.14).

Cellulæ cylindraceæ, angustæ; apicibus rotundatis; binæ in cœnobio mucoso involutæ.

Cœnob. (2 cell.) diam. 50; cell. long. 20, lat. 8 $\mu$ .

Botany.

A family of 4 cœnobia, in a vegetative Glæocystis-condition, noted. The mucus was somewhat laminated. There were two cells in each cœnobium, the chloroplasts showing the characteristic arrangement of *Chlamydomonas*. The cells were placed head to tail, and were narrower and more strictly cylindrical than usual. This form is another point in favour of my contention that *Glæocystis* and *Sphærocystis* are vegetative states of *Chlamydomonas*.

## CHLAMYD. GLOBULOSA var. PERTUSA, n.var.

Cellulæ sphericæ, fronte levissime deplanatæ. Chloroplastis angusto lineari foramine supra pyrenoidem instructa.

Cell. long. 18, lat. 20; foramin. long. 6 $\mu$ .

Lismore (263). (Pl. lvi., f.15).

Plentiful in gathering No 263. The cell is slightly but distinctly flattened in front, the membrane incrassate; and there is a narrow, linear aperture in the chloroplast just above the pyrenoid.

CHLAMYD. MONADINA var. OVALIS, n.var.

Cellulæ exacte ovales. Long. 22-24, lat. 17-20; pyren. long. 10, lat.  $2\mu$ .

Lismore (263). (Pl. lvi., f.16).

Instead of the spherical shape of the type, this form is a perfect oval. The pyrenoid, as usual, is strap-shaped, and  $10 \times 2\mu$  in dimensions.

CHLAMYDOMONAS GLOBOSA SNOW. (Pl. lvi., f.17).

Cell. diam.  $8-12\mu$ . Auburn; Lismore (263).

*Cf.* Julia W. Snow, Plankt. of L. Erie, Bull. U. S. Fish. Comm., 1902. The specimens from Lake Erie were  $5-8\mu$  in diameter. In ours, the chloroplasts were not fully formed, being gathered towards the hinder part of the cell. Stigma distinct.

CHLAMYDOMONAS LISMORENSIS, n.sp. (Pl. lvi., f.18).

Cellulæ minutæ, oblongæ; lateribus levissime arcuatis pæne parallelis; apicibus rotundatis; stigmatæ bacilliformi.

Cell. long.  $8-10\frac{1}{2}$ , lat.  $3-5\mu$ .

Auburn; Lismore (263, 299).

In the warm waters of tropical and subtropical countries, there is a tendency for flagellates to become motile at a very early stage of their development. This is a very small form, oblong, almost cylindrical with rounded ends; the usual bell-shaped chloroplast very shallow behind, no pyrenoid, as a rule.

Var. OVATA, n.var. (Pl. lvi., f.19, 20).

Cellulæ elongatæ, ovatæ, postice late-rotundatæ, fronte attenuatæ; apicibus acuminatis. Cell. long. 10, lat.  $3-5\mu$ .

Lismore (298).

Elongate elliptical-ovate in shape, broadly rounded behind,

gradually attenuate towards the apex, which is more or less acuminate. Both this form and the type are very active. Distinct central nucleus, very rarely a pyrenoid, stigma wick-shaped, orange or red, in the anterior third of the cell. It is possible that this form is identical with *Chl. mucicola* Schm.,\* Alg. d. Schwarzw. u. d. Oberrh., p.17, T. ii., f.4-8, which it very much resembles. The latter, however, has a *central pyrenoid*, and the *nucleus posterior to it* in the end of the cell ("In der Körpermitte ist ein . . . pyrenoid und hinter demselben der sehr kleine Zellkern") and no stigma.

Genus PHACOTUS Perty.

PHACOTUS BULLATUS, n.sp. (Pl. lvi., f.21, 22).

Cellulae, a fronte visæ, circulatæ vel subcirculatæ, margine inæquali; a latere subhexagonæ, infra apices constrictæ, apicibus rotundatis, lateribus planis vel paullulo retusis; a vertice cruciatæ, late-lineares bullis magnis singulis utrinque in medio instructis; membrana aspera dilutissime rufescente.

Cell. long. 13-14, lat. 13, crass. 9 $\mu$ .

Lismore (263).

Found in quantity in company with *Pteromonas cruciata*, infra. The cells, in front view, are generally subcircular; a broad ridge runs down front and back, beginning and ending a little within the apices. In lateral view, these show as produced ridges on either side. End-view cruciform, the ridges appearing as large, central, capitate bosses. Membrane very minutely rough, and very faintly coloured.

Var. CONICUS, n.var. (Pl. lvi., f.23).

Cellulae conicæ, fronte truncatæ, a tergo acuminatæ; lateribus arcuatis.

Cell. long. 16, lat. 13 $\mu$ .

Lismore (263).

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\* *Chl. mucicola* Schm., in Wille, Alg. Notizen ix.-xiv., p.136, by a slip of the pen, for Schmidle says, p.18, "Sie lebt in der Gallerte des Froschlaiches" (frogspawn).

## Genus PTEROMONAS Seligo.

## PTEROMONAS CRUCIATA, n.sp. (Pl. lvi., f.24, 25).

Cellulæ ovales alis geminatis binis cruciatim dispositis instructæ; a fronte visæ (alis inclusis) ovata, postice acuminatæ, margine inæquali aspero; a latere inæqualiter quadratæ (alis inclusis) anteriore angustatæ fronte truncatæ, lateribus planis, postice levissime arcuatæ, apice in bulla conica projiciente; a vertice cruciformes, corpore rhomboideo, angulis productis. Membrana hyalina.

Cell. long. s. alis 16-20, lat. 10-12; c. alis long. 24, lat. 18 $\mu$ .

Lismore (263).

The body is oval, with contents as in *Chlamydomonas*, save that the red spot is placed towards the hinder end. The cell is furnished with two pairs of wings lying in planes which intersect at right angles, making the end-view cruciform.

## Var. PULCHRA, n.var. (Pl. lvi., f.26).

Cellulæ a latere angulis alarum inferioribus truncatis et protractis, lateribus paullo retusis; ceteris ut in f. typica.

Cell. c. alis long. 24, lat. fronte 12, postice 18 $\mu$ . Alæ long. 20 $\mu$ .

Lismore (263).

The lower angles of one pair of wings are truncate and produced, the sides somewhat retuse. A pyrenoid present, as a rule, in both type and variation.

## Genus VOLVULINA Playf.

## VOLV. STEINII var. LENTICULARIS Playf., forma.

Cænob. diam. 32-50; cell. diam. 10, inter se dist. 1 $\mu$ , alt. in sect. optical. 5-12 $\mu$ . Lismore (263, 293).

A new locality for *Volvulina*. The cænobium gives the impression that the cells are the result of fragmentation of a parietal chloroplast. From above, the cells are generally quadrate or polyhedral, fitting into one another, the edges not more than 1 $\mu$  apart; sometimes, however, they are circular. The cells are certainly lenticular in optical section. There are 16 in the cænobium, arranged more or less in three layers, 4 + 1, 6, 4 + 1.

## HYDRODICTYACEÆ.

Genus PEDIASSTRUM Meyen.

PEDI. TETRAS var. FLUVIATILE, n.var. (Pl. lvii., f.1).

Cellulæ sinu rectangulo, in brevem angustam fenestram introrsum producto, minime incisæ; angulis exterioribus apiculo minuto instructis.

Cenob. (4 cell.) long. 18, lat. 18 $\mu$ .

Lismore (188).

Instead of being deeply incised, the cells merely have the outer angle excised by a more or less rectangular sinus, the point of which is produced inwardly into a short loop. The free angles are minutely apiculate. The markings in the cells are not pyrenoids, but vacuoles in the cytoplasm; under a low magnification, they appear so plainly as to be easily mistaken for a part of the sinus. Cf. *P. rotula* Kütz., in Nägeli, Gatt. einz. Alg., T.vb, fig.3c.

Var. APICULATUM, n.var. (Pl. lvii., f.2).

Cellulæ extrorsum sinu amplo leviter excisæ, vel alte emarginatæ; angulis rotundatis, minuto hyalino apiculo instructis.

Cenob. (8 cell.) diam. 22; cell. diam. 7 $\mu$ .

Botanic Gardens (125).

Syn., *P. tetras* var. *integrum* (Näg.) Playf., Biol. Richm. R., p.110, Pl. iii., f.26. *P. integrum* Næg., has the outer edge of the cell quite flat. In this form, the cells are slightly excised by a wide, shallow sinus, or else deeply emarginate; the angles are rounded, and furnished with a minute, hyaline apiculus.

## PROTOCOCCACEÆ.

Genus CRUCIGENIA Morren.

The species of *Crucigenia* are, to my thinking, merely infantile forms of *Pediastrum*, developed from the resting-cell or zygospore, which is the outcome of the union of gametes. This resting-cell, or something very near to it, I have described and figured under the name of *Pedi. tetras* var. *unicellulare* in "Plankton Sydney Water-Supply," p.517, Pl.56, f.4. In spite



of their probable connection with *Pediastrum*, it is convenient to arrange these forms under a separate genus, even if it is only a conventional one. Those mentioned, *l.c.*, these Proceedings, 1913, may be summarised thus:—

CRUCIGENIA AUSTRALIS mihi.

Syn., *Pedi. tetras* var. *australe* Playf., *l.c.*, p.516, Pl.56, f.2.

CRUCIGENIA TETRAPEDIA (Kirch.) W. & G. S. West.

Cænob. (4 cell.) long. 7-8, lat. 7-8 $\mu$ .

Fairfield (130).

Syn., *Pedi. tetras* var. *tetrapedia* (Kirch.) Playf., *l.c.*, p.517, Pl.56, f.3; also *Pedi. tetras* var. *quadratum* Playf., *ibid.*, Pl.56, f.3a, which differs hardly at all from *C. tetrapedia*.

Var. ORNATA, n.var. (Pl. lvii., f.3).

Cænobium (4 cell.) parvo cytoplasmatis granulo ad angulos ornatum.

Cænob. long. = lat. = 7-8 $\mu$ . Fairfield (130).

The cænobium of *C. tetrapedia* is formed from a single cell by the gradual division of the contents into four, from the centre outwards. The last sign of this division is a slight band of cytoplasm connecting the outer angles of the cells. Cf. Chodat, Alg. vertes, p.222, f.148a, No.2 (sub nom. *Leunermannia emarginata*) and my figure in Plankton Sydney Water-Supply, Pl.56, f.3 (*Pedi. tetras* var. *tetrapedia*). The small, chlorophyllaceous granule found in var. *ornata* seems to be brought about by the segregation of this band.

CRUCIGENIA FLORALIS, nom.nov.

Cænobium in medio foramine parvo rectangulari instructum; cellulis binis rotundato-ovatis, alteris oblongis, cruciatim dispositis.

Cænob. long. 8, lat. 7 $\mu$ . Potts Hill (138).

Syn. *Pedi. tetras* var. *triangularis* (Chod.) Playf., forma, *l.c.*, p.517, Pl.56, f.5. This form is not strikingly like *Crucigenia triangularis* Chodat, although the upper and lower cells are somewhat ovate.

## CRUCIGENIA CORDATA, nom.nov.

Cœnob. in medio foramine parvo rectangulari instructum; cellulis plus minusve cordiformibus, utrinque ad apices apiculo minuto interdum ornatis.

Cœnob. (4 cell.) long. 25, lat. 23 $\mu$ ,

Botanic Gardens (158).

Syn., *Pedi. tetras* var. *integrum* (Näg.) Playf., forma, *l.c.*, p.518, Pl.56, f.7. The cells are more or less heart-shaped, and are often tipped with a minute, indistinct apiculus. The species should be compared with *Pedi. tetras* var. *apiculatum*, supra.

## CRUCIGENIA TRIANGULARIS Chodat. (Pl. lvii., f.4).

Cœnob. diam. 10-16; cell. diam. ca. 5-7 $\mu$ .

Collector; Guildford (88); Lismore (188).

*Cf.* Chodat, *Alg. vertes*, p.223, f.14-19. The cœnobium consists nearly always of 4, minute, pale green, ovate cells, occasionally with pyrenoids.

## CRUCIGENIA QUADRATA var. SECTA, n.var. (Pl. lvii., f.5).

Cellulæ circulatæ in partes subtriangulares 4 per crucem divisæ.

Cœnob. (4 cell.) long. 6, lat. 6; cell. diam. ca. 2 $\mu$ .

Lismore (188). Cum *C. rectangulari*.

The original cœnobium, before division, must have been constituted of 4 circular cells arranged in a square; hence, I have placed this form under *C. quadrata* Morren, *cf.* G. S. West, Brit. Frw. Alg., p.216, f.90D, E. Pale green in colour.

## Genus TETRASTRUM Chodat.

## TETRASTRUM ELEGANS, n.sp. (Pl. lvii., f.6).

Cœnobium (4 cell.) quadratum; cellulis subcirculatis distinctis, extrorsum spinis longis tenuissimis singulis ornatis.

Cœnob. diam. c. sp. 28, cell. diam. 4 $\mu$ .

Parramatta (136).

This species might be described as a spinous form of *C. quadrata* Morren, just as *T. staurogeniæforme* of *C. triangularis*

Chodat. The cells are subcircular, arranged in a square, and each furnished with a long, thin, delicate spine. Cytoplasm pale green.

Var. DENTATUM, n.var. (Pl. lvii., f.7).

Cenobium (4 cell.) quadratum vel rhomboideum; lacuna distincta rectangulari; cellulis plus minusve ovatis adpressis, lateribus angulatis, ad apices spinis longis tenuissimis singulis instructis et altero latere dentibus vel spinis brevibus singulis.

Cenob. (4 cell.) c. sp. diam. 30-38; cell. diam. 3-4 $\mu$ .

Parramatta (136).

In this form, the cells are more or less ovate, with angular sides, adpressed, the apices outwards, and furnished with a long, thin spine. A little lower down, on one side, is a second, much smaller spine or tooth. The lacuna is sharply rectangular.

#### Genus CÆLASTRUM Näg

*Cæl. microporum* Näg., is by far the most common form in this country, and, next to it, *Cæl. crenatum* Arch. *C. sphericum* Näg., very rare.

#### CÆLASTRUM CRENATUM Archer.

Cenob. diam. 32-83; cell. diam. 6-32 $\mu$ .

Collector, Rose's Lagoon; Botany (91); Guildford (124).

Cf. G. S. West, Brit. Frw. Alg., p.213, f.87A. Syn., *Cæl. pulchrum* Schm., Algentl. d. Schwarzw. u. d. Rheineb., T. ii., f.10.

Var. CUBICUM, n.var. (Pl. lvii., f.8).

Cenobium plus minusve cubicum angulis truncatis; cellulis quattuor circa unum ordinatis; foraminibus amplis octagonis.

Cenob. diam. 33-55; cell. diam. c. 10 $\mu$ .

Guildford (77).

Generally the cells are arranged 5 or 6 round one, in this form 4, which gives the cenobium a cubical or octagonal shape; the foramina, also, are wide and octagonal in outline. Very like *C. cubicum*, but that species has three projections to each cell, two visible at the margin.

*CÆLASTRUM OBTUSUM* (Eichler) mihi. (Pl. lvii., f.9).

Cellulæ conicæ e basi ipsa protractæ; apicibus rotundatis nec truncatis; foraminibus amplis.

Cenob. (8 cell.) diam.  $24\mu$ . Collector.

Syn., *C. cubicum* var. *obtusum* Eichler, Flory wodor ok. Miedzyr., 1894, p.122, T. ii., f.1, where he gives "diam. cænob. 17-20 $\mu$ ." The cells are conical, drawn out right from the base, with rounded apices. Compare *C. pseudo-cubicum* Schröd., Plöner Berichte, v., 1897, T. iii., especially fig.1a. His figures show conclusively that *C. proboscideum* Bohlin, *C. cubicum* Näg., and this form of Eichler's are, biologically, one species. The last differs too much from *C. cubicum*, however, to be placed under that species, and it has priority over *C. proboscideum* Bohlin, 1897.

GENUS *SELENASTRUM* Reinsch.

*SELENASTRUM GRACILE* Rein.

Cell. long. 18-25, alt. c. 18, crass. 3-8 $\mu$ .

Botanic Gardens (125); Clyde, Duck Creek (26); Sydney Water (63); Lismore (182, 260).

Reinsch, Algenfl. v. Frank., p.65, T. iv., f.3a, b. This species is often found in the form of two cells back to back. There are generally only a few cells in the cænobium. A family of 8 cænobia, of 8 cells each, was noted. Solitary cells are not uncommon.

Var. *MINUTUM*, n.var. (Pl. lvii., f.10).

Cellulæ dimensionibus dimidio minores quam in f. typica.

Cell. long. 9-18, alt. 7-8, crass.  $1\frac{1}{2}$ -2 $\mu$ .

Botanic Gardens (125); Lismore (298).

GENUS *SCENEDESMUS* Meyen.

*SC. QUADRIKAUDA* var. *INCURVUS*, n.var. (Pl. lvii., f.11).

Forma spinis apicalibus incurvis. Cenob. (4 cell.) s.sp.  $30 \times 22\mu$ . Centennial Park.

*Cf.* Ralfs, Brit. Desm., T.31, f.12a, b. The terminal spines are generally divergent, but in this form they are incurved.

Var. *INERMIS*, n.var (Pl. lvii., f.12, 13).

Forma sine spinis. Cœnob. (4 cell.) 15-20 × 11-12 $\mu$ .

Botany (145); Lismore (260); Enoggera.

Not  $\gamma$  *ecornis* Ralfs, Brit. Desm., T.31, f.12h [= *Sc. bijugus* (Turp.)]. In the latter, all the cells are of the same size, and are regularly or irregularly oval. In var. *inermis*, the outer cells are slightly smaller than the inner, the latter also being strictly cylindrical, with parallel sides and rounded ends.

*SC. DENTICULATUS* var. *GRACILIS*, n.var. (Pl. lvii., f.14).

Cellulae gracillimae, lineares, elongatae, lateribus parallelis.

Cœnob. (4 cell.) long. 12-21, lat. 12-20; cell. diam. 3-5 $\mu$ .

Botany (17, 50, 95, 145, 155); Guildford (70); Centennial Park (133); Lismore (187).

Much more common here than any other form of *Sc. denticulatus*. The cells are linear and very slender, with parallel sides, cœnobia generally 4-celled.

Var. *OPOLIENSIS* (Richter) mihi.

Cœnob. (2 cell.) s.sp. long. 8-12, lat. 12-15; sp.long. 6-10 $\mu$ .

Botany (50, 108); Parramatta (136); Enoggera.

Syn., *Sc. opoliensis* Richter, Phycotheca universalis, No.686; *Sc. quadricauda* var. *opoliensis* (Richter) W. & G. S. West, Frw. Alg. Ceylon, p.197, Pl.17, f.16, 17. The apical denticulations stamp this form as a variation of *Sc. denticulatus*. The presence of the long, terminal spines in *Sc. hystrix* var. *armatus* Chodat (also found here) shows that they are not necessarily indicative of *Sc. quadricauda*.

Var. *AUSTRALIS*, n.var. (Pl. lvii., f.15).

Cellulae dentibus singulis ad apices instructae; long. s. dent. 16, lat. 6 $\mu$ . Collector.

Forms of *Sc. denticulatus* generally have two or three denticulations at the apices; in this form, there is one only. Cf. G. S. West, Br. Frw. Alg., p.220, fig.92j.

*SCENEDESMUS SECURIFORMIS*, n.sp. (Pl. lvii., f.16, 17).

Cellulae exteriores (interdum etiam medianae) modice securiformes, spinis nullis.

Cœnob. (2 cell.) 8-9 × 6-8; (4 cell.) 12-18 × 8-14 $\mu$ .

Casino (189) and Lismore (187), Richmond River.

The outer cells are almost rectangular, and somewhat securiform; the central cells are sometimes the same shape, sometimes cylindrical with rounded ends.

Genus ANKISTRODESMUS Corda.

Syn., *Rhaphidium* Kütz., *Schröderia* Lemm.

ANK. FALCATUS var. MIRABILIS W. & G. S. West. (Pl. lvii., f.18).

Cell long. 36-90, lat. 1-3 $\mu$ .

Botany (37, 155); Clyde, Duck Creek (26, 44); Canley Vale (129); Guildford (172); Sydney Water (63); Enoggera; Perth Water.

Syn., *Rhaph. polymorphum* var. *mirabile* W. & G. S. West, Frw. Alg. S. of Eng., p.501, Pl.7, f.9-13. The contents are generally homogeneous, and of a pale blue tint.

Var. CONTORTUS (Thuret) mihi. (Pl. lvii., f.19).

Cell. long. 16-60, lat. 2-3 $\mu$ .

Clyde, Duck Creek (26); Canley Vale (129); Botanic Gardens (156); Lismore (258).

In Brébisson, Liste, p.158, Pl.1, f.31. I have found this form in quantity on several occasions. There is a tendency for the apices to be setaceous, but not to the extent of var. *setigerus* (*Schr. setigera*).

ANKISTRODESMUS DULCIS, n.sp. (Pl. lvii., f.20).

Cellulæ solitariae, valde æqualiter arcuatæ, gracillimæ, apicibus acutissimis haud autem setiformibus; chloroplastidibus homogeneis, ab apicibus retractis, medio interdum interruptis; elæoplastidibus singulis nunquam in extremis, interdum etiam in locello mediano, instructis; pyrenoidibus nullis.

Cell. long. (chorda) 30-70, crass. 2-4, alt. 20-40 $\mu$ .

Botany (155); Parramatta Park (136); Sydney Water (63, 100); Lismore (258).

Var. CINGULUM, n.var. (Pl. lvii., f.21).

Cellulæ magis arcuatæ, tres quadrantes circuli efficientes, apicibus modice incurvis. Cell. long. (chorda) 26, crass. 2, alt. 20 $\mu$ .

Botany (92).

A very pretty species, both from its graceful curvature and from the disposition of the cell-contents. The cell has the regularly arched form of a *Closterium*, very slender and gradually narrowing to the very acute tips. The latter are not drawn out into setæ, and are not incurved. The homogeneous chloroplast is generally confined to the body of the cell, leaving the tips clear; it is also often interrupted in the centre, or there is a locellus at the centre, placed to one side. Very often, an elæoplast is situated at each end of the chloroplast, sometimes also one in the middle. In var. *cingulum*, the curvature extends over three parts of a circle, the ends being somewhat incurved.

ANKISTRODESMUS BRAUNII (Näg.), forma. (Pl. lvii., f.22).

Cell. long. 40, lat. 3 $\mu$ . Lismore (196).

The figure shows four cells, produced by longitudinal division, and still connected by the membrane of the mother-cell, which has become twisted into a stipes.

Var. MINUTUS, n.var. (Pl. lvii., f.23-25).

Cellulæ parvæ, longitudine usque ad formæ typicæ dimidium.

Cell. long. 10-20, lat. 2-3 (rarius 5)  $\mu$ .

Lismore (182, 191, 196).

Cells only half as long as those of the type (or less), and generally a little more lunate, sessile on pieces of flocculent matter, water-plants, etc.

Genus ACTINASTRUM Lagerh.

ACTINASTRUM HANTZSCHII Lag. (Pl. lvii., f.26, 27).

Cœnob. (2 cell.) diam. 54, cell. 25  $\times$  4; (4 cell.) diam. 28-50, cell. 16-25  $\times$  2-4; (8 cell.) diam. 40-50, cell. 20-30  $\times$  2-3 $\mu$ .

Parramatta (136); Botany (50); Lismore (258); Grafton, Nymboidia River (269).

Lagerheim, *Pedi. Protococc. o. Palm.*, p.70, T. iii., f.25, 26. Cells somewhat fusiform, outer ends acute, inner ends blunt. In all forms of *Act. Hantzschii*, the cell-contents are indifferently hyaline, pale blue or pale green. The chloroplast, when distinct, is generally somewhat retracted from the apex, and an elæoplast is often present.

*ACTINASTRUM BACILLARE*, n.sp. (Pl. lvii., f.28, 29).

Cellulæ bacilliformes, gracillimæ. Cænob. (8 cell.) diam. 16-35, cell.  $8-20 \times 1\frac{1}{2}-2\mu$ .

Parramatta Park (136); Lismore (274).

The cells, instead of being fusiform, are narrow and linear, sometimes very short.

*ACTINASTRUM ACICULARE*, n.sp. (Pl. lvii., f.30).

Cellulæ subulatæ, modice arcuatæ, basi inflatæ, apice acutæ.

Cænob. (8 cell.) diam. 35, cell.  $22 \times 3\mu$ .

Lismore (274).

The cells are somewhat awl-shaped, slightly curved, inflated at the base, and acute at the tip. Contents pale blue, an elæoplast present.

*ACTINASTRUM GUTTULA*, n.sp. (Pl. lvii., f.31).

Cellulæ in modo guttulæ conformatæ, introrsum acutissimæ.

Cænob. (2 cell.) diam. 40, cell.  $20 \times 4\mu$ .

Parramatta Park (136).

A 2-celled cænobium noted with drop-shaped cells, the acute end inwards.

Genus *KIRCHNERIELLA* Schm.

*KIRCHNERIELLA ELEGANS*, n.sp. (Pl. lvii., f.32).

Cellulæ graciles; lateribus parallelis; apicibus obtusis in modo soleæ equi circumflectæ. Cell. diam. 6, crass.  $2\mu$ .

Sydney Water (63).

The cells in this form are very slender, with parallel sides and blunt ends, bent round into the shape of a horseshoe. A four-celled cænobium noted with cells disposed as figured,



KIRCHN. LUNARIS var. ACUTA, n.var. (Pl. lvii., f.33).

Cellulæ lunatæ; apicibus protractis acutissimis, longo intervallo inter se distantibus. Cell. diam. 8, alt. 7, crass.  $3\mu$ .

Botanic Gardens (150).

The apices of the cell, which are wide apart, are drawn out to a very acute point.

Genus OOCYSTIS Näg.

O. CRASSA var. OSTENFELDI Playf., forma. (Pl. lviii., f.1).

Chloroplastides 8, pyrenoidibus instructæ. Cell. long. 20, lat.  $13\mu$ .

Lismore (285).

Cf. "*Oocystis* and *Eremosphaera*," p.124, Pl.7, f.18, 19. This variation generally has 2-4 chloroplasts; here we have it with eight.

Var. ELONGATA, n.var. (Pl. lviii., f.2, 3).

Cellulæ longe-ovales; apicibus acute-rotundatis; chloroplastidibus 8. Cell. long. 25-27, lat.  $15\mu$ .

Lismore (285, 286).

The cells are more elliptic than in either the type or var. *Ostenfeldii*; the apices more or less pointed, not incrassate or apiculate. There is a parietal chloroplast, obviously fragmented into eight parts, with pyrenoids.

Var. GRANULOSA, n.var. (Pl. lviii., f.4).

Cellulæ late elliptico-lanceolatæ, lateribus æqualiter arcuatis, apicibus acuminatis. Membrana ad apices introrsum incrassata. Chloroplastides nullæ distinctæ, chlorophyllo diffuso, cytoplasmate granuloso.

Cell. long. 27, lat.  $19\frac{1}{2}\mu$ .

Lismore (298).

The nearest to the type that I have noticed, the shape broadly elliptic-lanceolate, with pointed, inwardly incrassate apices. There are, however, no distinct chloroplasts, nor yet a parietal lamina; but the contents are granular, and the chlorophyll apparently diffused. The nucleus was visible in the centre.

*O. APICULATA* var. *MAJOR* Playf.\* (Pl. lviii., f.5).

Cellulae ellipticae, duplo majores quam in f. typica, apicibus minute apiculatis.

Cell. long. 38, lat. 20 $\mu$ .

Lismore (286).

There are two forms of the type, an oblong and an elliptic. This is a larger form of the latter, as var. *splendida* is of the former. Cf. these Proceedings, Pl. viii., f.2; the figure there is not sufficiently elliptic, too oblong. This form is liable to be mistaken for *O. solitaria*; there is no anterior, apical incrassation, however, and an apiculus is present, though very small and inconspicuous.

Var. *SPLENDIDA* Playf.

Cell. long. 33-41, lat. 21-26 $\mu$ . Lismore (285, 286).

"*Ooc. and Eremo.*," p.131, Pl. viii., f.23. These figures extend the dimensions considerably. Var. *splendida* is a larger (about twice the size) and somewhat more elongate form of var. *obesa*. The two forms run into one another however.

Genus *NEPHROCYTIUM* Näg.

*N. AGARDHIANUM* var. *MAJUS* Näg. (Pl. lviii., f.6).

Cænob. long. 75-78, lat. 50-55; cell. long. 37, lat. 21 $\mu$ .

Guildford (23).

Syn., *N. Nägeli* Grun.; *N. obesum* West, New Brit. Frw. Alg., p.13, Pl. ii., f.39, 40. Cf. Nägeli, Gatt. einz. Alg., T. iii.c, fig. i, k, p. Nägeli's fig.p works out at 34 x 15 $\mu$  for the cells; West, l.c., gives "long. cell. 34-42, lat. cell. 24-28 $\mu$ " for *N. obesum*. Except in the slightly greater breadth of the cells, West's figures agree exactly with those of Nägeli.

Var. *PLANKTONICUM*, n.var. (Pl. lviii., f.7, 8).

Cænobium sphaericum mucosum. Cellulae lunatae 4-8 (plerumque 4) cunctae, per extremitates (ut videtur) conjunctae vel radiantes, ad apices angustatae, apicibus obtusis.

\* This form was mentioned in "*Oocystis and Eremosphaera*," p.110, but the description and notes were inadvertently omitted.

Cœnob. diam. 96-112; cell. long. 20-27, lat. 4-8 $\mu$ .

Botany.

The cœnobium consists of a mucous sphere, as in *Sphærocystis* or *Glæocystis*, with lunate cells, generally in groups of 4, which appear to be either joined loosely by the extremities, or radiate from a common centre.

Genus TETRALLANTOS Teiling.

TETRALLANTOS LAGERHEIMII Teiling. (Pl. lviii., f.9, 10).

Cœnob. (4 cell.) long. 38-40, lat. 20-24; (8 cell.) 54  $\times$  20; cell. long. 12-16, alt. 6-12, crass. 3-6 $\mu$ .

Botany (37, 152); Botanic Gardens (125); Lismore (258, 260).

*Cf.* Einar Teiling, Schwedische Planktonalgen, ii., *Tetrallantos*, eine neue Gattung der Protococcoideen, p.63, f.1-7, 1916.

Genus TETRAEDRON Kütz.

TETRAEDRON MINIMUM (A.Br.) Hansg. (Pl. lviii., f.11).

Cell. long. = lat. = 6-8 $\mu$ .

Parramatta Park (136); Guildford (88); Lismore (260, 276).

*Polyedrium minimum* A. Braun, Alg. unicell., p.94, footnote; G. S. West, Brit. Frw. Alg., p.231, fig.101A. The type has rather acute, radiating angles, and emarginate sides, alternate sides more deeply emarginate ("*lateribus alternis profundius emarginatis*"—A. Braun, *l.c.*) than the others. There are several well-marked forms of the species.

Var. AUSTRALE, n.var. (Pl. lviii., f.12, 13).

Cellulæ lateribus alteris planis levissime convexis, alteris altissime emarginatis.

Cell. diam. 5-8 $\mu$ . Botany (95); Lismore (180, 276).

Cell. diam. 10-12 $\mu$ . Botanic Gardens (3); Casino (189).

The most common form of the species here. The ends are flat or nearly so, slightly turned down at the angles, while the sides are very deeply emarginate and arched. In shape, it resembles *Tetr. platyisthmium* (Arch.) G. S. West, "Some critical green Algae," p.286, Pl.21, f.36-39, but is very much smaller, and cer-

tainly a form of *Tetr. minimum*, being commonly found in company with other forms of the species.

Var. PINACIDIUM (Reinsch) mihi. (Pl. lviii., f.14, 15).

Cell. long. 6-13, lat. 5-11 $\mu$ .

Botanic Gardens (3); Clyde, Duck Creek (26); Botany (108).

*Polyedrium pinacidium* Reinsch, Spec. generibusque, T.2A, f. iii.; Lagerheim, Pedi. Protococc. o. Palm., p.69, T. i., f.27. Syn., *P. minimum* f. *tetralobula* Reinsch, *Polyedr.* Monog., T. iv., fig.2d (forma *tetralobulata* in text, p.499); *P. tetragonum* Reinsch (non Näg.), l.c., T. iv., f.10. The cell is plane, with rounded angles, all four sides equally retuse. Reinsch and Lagerheim figure the cell as quadrate; our specimens were somewhat oblong.

Var. RECTILINEARE, n.var. (Pl. lviii., f.16, 17).

Cellulæ plus minusve quadratæ, lateribus rectilinearibus, angulis obtusis plus minusve rectis.

Cell. long. = lat. = 10-13 $\mu$ . Guildford.

Cells more or less regularly square, with flat sides and bluntly rounded angles. Cf. Bernard, Protococc. et Desm., f.467.

Var. MORSUM (W. & G. S. West) mihi. (Pl. lviii., f.18).

Cell. long. = lat. = 9 $\mu$ , constr. 8 $\mu$ .

Botanic Gardens (3).

*Tetrapedia morsa* W. & G. S. West, Frw. Alg. Madag., p.85, Pl. v., f.3. The sides of the angles are flattened, and run back at right angles from the apex, for about one-third the length of the side of the cell. The other third is occupied by a sudden, rounded excavation. Cell plane, contents green; found in company with var. *pinacidium* and the type, very rare.

TETRAEDRON REGULARE Kütz., forma. (Pl. lviii., f.19).

Cell. diam. c. sp. 34, s. sp. 24 $\mu$ . Parramatta (136).

Kützing, Phycolog. germ., p.129. Syn., *Polyedrium tetraedricum* Näg., pro parte, Gatt. einz. Alg., T. iv.B, fig.3c, d. *P. trigonum* Näg., p.p., loc. cit., T. iv.B, fig.1c, d. I am in great doubt as to the characteristics of this type. Both Chodat, Alg. vertes, p.220, f.146, and G. S. West, Brit. Frw. Alg., p.231, f.101c,

identify Kützing's plant with *P. tetraëdricum* Näg., but their figures do not agree with one another nor even exactly with Nägeli's figures. Also Nägeli gives the same two types to *P. trigonum* and *P. tetraëdricum*, relying for a specific characteristic on the plane or tetraëdral form of the cell. There is no biological difference, however, between plane and tetraëdral cells, the latter being developed often from the former; and as the classification is on the basis of outward configuration, it is extremely inconvenient to have types of a mixed character. The occurrence of biradiate and triradiate forms in the same type is well known in the Desmid genus *Staurastrum*, and these are strictly analogous to the plane and tetraëdral forms of *Tetraëdron*. I consider, therefore, that Nägeli's T. iv.B, fig. 1a, and T. iv.B, fig. 3a, b, should be arranged under *Tetr. trigonum*, while T. iv.B, fig. 1c, d, and T. iv.B, fig. 3c, d, should be classed as *Tetr. regulare* (*tetraëdricum*).

Var. INERME, n.var. (Pl. lix., f.17).

Cellulæ planæ; lateribus leviter concavis; angulis levissime inflatis; spinis nullis. Cell. diam. 14, crass. 6 $\mu$ .

Collector.

The cells are plane, and have the concave sides and slightly inflated angles of the type, but are without spines.

Var. PAPILLIFERUM (Schröd.) mihi, forma. (Pl. lviii., f.20).

Forma maxima tetraëdrica; cellulæ obesæ; lateribus paullo concavis; angulis latis, inflatis, papillis singulis præditis.

Cell. diam. 64 $\mu$ . Collector, Rose's Lagoon.

Cf. *Polyedrium trigonum* var. *papilliferum* Schröder, Plöner Berichte, v., 1897, T. ii., f.6. In optical section, our form is the exact same shape as Schröder's, from which it differs in its tetraëdral form, and very much larger size (diam. 12-15 $\mu$ —Schröder). Both forms, with their hollow sides and inflated angles, naturally fall under *Tetr. regulare*, though somewhat more plump than figured by Nägeli (*P. tetraëdricum*). Cf. G. S. West's form, *l.c.*, *supra*. The occurrence of a plane and tetraëdral variety, in such a distinct form as this, goes far to bear out my contention, that there is no biological difference between them, but that both may be found in the same species.

## TETR. SPINULOSUM Schm., forma. (Pl. lviii., f.21).

Forma pentaëdrica; lateribus subplanis; angulis obtusis; spinis tenuibus setis simillimis. Cell. corp. diam. 18 $\mu$ .

Lismore (290).

*Cf.* Chodat, Alg. vertes, p.221, f.147B. This form has the sides almost flat, the angles obtuse, and very delicate spines like setæ.

## Var. EXCAVATUM, n.var. (Pl. lviii., f.22).

Forma pentaëdrica, valde excavata; angulis radiantibus, conicis, hand inflatis, lateribus planis, apicibus modice acutis, spinis tenuissimis instructis. Cell. corp. diam. ca. 20 $\mu$ .

Lismore (290).

In this form, the body is much more excavated on all sides; the cell consists of little more than 5, conical, radiating angles, not inflated, but with nearly flat sides, and rather acute at the apices. Spines very delicate.

## TETRAEDRON HORTENSE, n.sp. (Pl. lviii., f.23).

Cellulæ maximæ, æqualiter tetraëdricæ; lateribus levissime concavis; angulis late-rotundatis. Membrana minute punctulata, ad extremos angulos interdum levissime granulata, punctis in seriebus duabus decussatim ordinatis. Cell. diam. 46-72 $\mu$ .

Botanic Gardens (3, 150); Prospect Reservoir.

Compare, with this species, *Tetr. gigas* Wittr., Gotl. o. Oelands Söttvattensalg., p.33, T.4, f.4, and *Tetr. tumidulum* Reinsch, *Polyedr. Monog.*, p.506, T. vi., f.3. The cells are very large, tetraëdral, generally with broadly rounded angles, and very slightly concave sides; the angles, however, sometimes tend to be pointed. The membrane is minutely punctate all over, the puncta arranged in decussating lines.

## TETRAEDRON ACUTUM, n.sp. (Pl. lviii., f.24, 25).

Cellulæ tetraëdricæ; lateribus plus minus (sæpe valde) concavis, angulis protractis; angulis spinis singulis instructis.

Cell. diam. c. sp. 20-34; sp. long. 6-10 $\mu$ .

Parramatta (136); Lismore (258, 259, 263); Enoggera.

The cells are tetraëdral; in optical section, triangular, with

more or less concave sides, angles very acute and produced. The angles are furnished with fine spines; it is sometimes difficult to say where the angle ends and the spine begins.

Var. RECTILINEARE, n.var. (Pl. lviii., f.26).

Cellulæ tetraëdrice; lateribus planis nec retusis; angulis acutis haud protractis, spinis singulis præditis. Cell. diam. c. sp. 25 $\mu$ .

Enoggera.

The cell is tetrahedral; in optical section, triangular, with sides quite flat, angles acute, not produced, furnished with short spines. Nägeli's figure, Gatt. einz. Alg., T. iv, B, fig. 1b, is a plane form of this variation.

TETR. HASTATUM var. ELEGANS, n.var. (Pl. lviii., f.27).

Cellulæ tetraëdrice; lateribus concavis; angulis in processus hyalinos bifidos singulos protractis. Cell. diam. c. proc. 32 $\mu$ .

Parramatta Park (136).

Cf. *Tetr. (Polyedrium) hastatum* Reinsch, Algenfl. v. Frank., p.77, T. v., f.3, also Chodat, *l.c.*, p.172, f.95. The sides of the cell are very concave, and the single process at each angle more regular; the processes are hyaline, and bifid, with recurved ends, sometimes doubly dichotomous.

TETR. TRIGONUM var. MAMMILLATUM, n.var. (Pl. lviii., f.28).

Cellulæ planæ triangulares; lateribus convexis; angulis obtusis in papillas singulas productis; a latere visæ lenticulares.

Cell. diam. 12 $\mu$ . Lismore (258).

Cf. *Tetr. (Polyedrium) trigonum* var. *crassum* Näg., in Eichler, Flor. wodor. ok. Miedzyrzecza, 1892, T. ix., f.17. This form has each angle produced into a short, mammillate projection.

TETRAEDRON CRUCIFORME, n.sp. (Pl. lviii., f.29).

Cellulæ planæ, angulis radiantibus 4 exstructæ, medio valde constrictæ, inferne et superne retusæ; angulis acutis vix inflatis, spinis minutis singulis instructis. Chloroplastides dilute virides.

Cell. long. c. sp. 18, centr. 10; lat. c. sp. 20, constr. 6 $\mu$ .

Botany.

A plane form, deeply constricted in the middle after the style

of an *Arthrodesmus*, and somewhat retuse above and below, the angles acute, hardly inflated and furnished with a minute spine.

TETRAEDRON STRIATUM, n.sp. (Pl. lviii., f.30).

Cellulæ tetraëdricæ; lateribus valde concavis; angulis haud inflatis in processus angustos breves protractis, extremis truncatis, transverse striatis. Cell. diam 26 $\mu$ .

Enoggera.

The cell is tetraëdral, with very concave sides, angles not inflated but produced in short processes, like certain forms of *Staurastrum*; processes narrow, transversely striate (? rows of puncta), ends truncate.

TETRAEDRON WASTENEYSII, n.sp. (Pl. lviii., f.31).

Cellulæ tetraëdricæ; lateribus convexis; angulis obtusis in processus breves hyalinos claviformes singulos productis.

Cell. diam. c. proc. 20, corp. 8 $\frac{1}{2}$  $\mu$ . Enoggera.

Named in honour of my erstwhile correspondent, Mr. Hardolph Wasteneys, who sent me the Enoggera-samples. The cell is tetraëdral, the body with convex sides; the obtuse angles are produced into short, hyaline, club-shaped processes, with smooth, rounded ends.

PHYTHELIEÆ.

Genus RICHTERIELLA Lemm.

RICHTERIELLA BOTRYOIDES (Schm.) Lemm. (Pl. lix., f.1, 2).

Cell. diam. 3-8; setæ long. 20-30 $\mu$ .

Parramatta Park (136).

Genus LAGERHEIMIA Chodat.

Including *Chodatella* Lemmermann. In "Plankton of the Sydney Water-Supply," these Proceedings, 1912, in consideration of their evident connection, one with another, I felt bound to arrange the various forms of *Lagerheimia* as variations of one species. While just as much as ever convinced of the biological connection, I find this method of nomenclature cumbrous, and of



very doubtful utility, and have abandoned it. The following list gives the revised nomenclature:—

- L. genevensis* Chod., p.p. = *L. ciliata* v. *genevensis*, lc., p.522,  
Pl. 53, f.7.  
,, var. *gracilis* Playf. = *L. ciliata* v. *gracilis*, p.523, f.10-12.  
*L. acuminata* Playf. = ,, v. *acuminata*, p.523, f.13-19.  
*L. globosa* Playf. = ,, v. *globosa*, p.524, f.20.  
*L. cristata* Playf. = ,, v. *cristata*, p.525, f.21.  
*L. comosa* Playf. = ,, v. *comosa*, p.525, f.26.  
*L. subsalsa* (Lemm.) mihi = ,, v. *subsalsa*, p.524, f.32, 33.  
*L. coronata* Playf. = ,, v. *coronata*, p.522, f.3.  
,, var. *inflata* Playf. = ,, v. *inflata*, p.522, f.4, 5.  
,, var. *striolata* Playf. = ,, v. *striolata*, p.525, f.22, 25.

Genus BERNARDIA, \* gen.nov.

Cellulæ sphaericæ vel oblongæ, spinis (neque setis) longis, rigidis 4 (polaribus 2, equatorialibus 2) armatæ, basibus spinarum expansis. In cellulis maturioribus processus gracillimi, basibus valde expansis, apicibus obtusis vel minute cuspidatis, in vicem spinarum inveniuntur.

BERNARDIA CHODATI (Bernard) mihi. (Pl. lix., f.3, 4).

Cellulæ sphaericæ, spinis rigidis 4 (polaribus 2, equatorialibus 2) instructæ; spinis e papillis orientibus.

Cell. diam. 7, spin. long. 16 $\mu$ .

Dunedin, N.Z.; Enoggera, Q.

Syn., *Lagerheimia Chodati* Bernard, Protococc. et Desm., p.170, f.349, 350. In its younger stages, this plant resembles a *Lagerheimia*, but, instead of hair-like or bristle-like setæ, the cells are furnished with four rigid spines (“*forte barbe roide . . . . à l’extrémité très fine et très aiguë*”—Bernard); and these are not subapical, but exactly polar and equatorial. More mature cells, gathered from the lake in Parramatta Park, have convinced me, however, that the plant is organised on quite different lines to *Lagerheimia*. The stiff spines have become very slender processes, with blunt or minutely cuspidate apices, and very

\* In honour of M. Chas. Bernard, Dr. ès Sciences, of Buitenzorg, Java.

strongly expanded bases, so broad, indeed, as sometimes to enclose the whole cell. The processes are akin to those of *Staurastrum* or the horns of *Pediastrum*. Indeed, the fully developed plant resembles nothing so much as a four-celled *Pedi. simplex*. Bernard gives, cells 5-10 $\mu$ , spines 13-20 $\mu$ , for Javanese specimens.

Var. CRUCIATA, n. var. (Pl. lix., f. 5, 6).

Cellulæ in vicem spinulorum processibus longis gracillimis 4 (polaribus 2, equatorialibus 2) basi valde expansis, instructæ; membrana sæpe dilute rufescente.

Cell. diam. 6-12, process. long. 18-27 $\mu$ .

Parramatta Park (136).

In this, apparently the mature, form, the spines are replaced by long, slender processes, greatly expanded at the base; see notes on the type, *supra*.

BERNARDIA WRATISLAVENSIS (Schröd.) mihi. (Pl. lix., f. 7).

Cell. long. 8, lat. 3; spin. long. 16 $\mu$ ,

Lismore (258).

Syn., *Lagerheimia Wratislavensis* Schröder, Ber. d. deutsch. bot. Gesellsch., xv., T. 17, f. 7; Chodat, Alg. vertes, p. 188, f. 103. This form has spines arranged as in *Be. n. Chodati*, and should accompany that species. The spines and processes, also, in this genus are more or less rufescent, which I have never noted in the setæ of *Lagerheimia*.

## DICTYOSPHERIÆ.

Genus TETRACOCCLUS West.

TETRACOCCLUS BOTRYOIDES West. (Pl. lix., f. 8, 9).

Cell. diam. 3-8 $\mu$ . Lismore (285).

## PALMELLACEÆ.

Genus SPHEROCYSTIS Chod.

SPHEROCYSTIS SCHROETERI Chod. (Pl. lix., f. 10).

Cænob. diam. 28-300; cell. diam. 3-12 $\mu$ .

Botany; Sydney Water (80, 81); Lismore (260, 281, 286); Grafton, Nymboidia River (268).

*Cf.* Chodat, Bull. de l'Herbier Boissier, 1897, p.292, T. ix.; Alg. vertes, p.114, f.53. I have never been able to see any difference between *Glæocystis* and *Sphærocystis*, except that cœnobia of the latter run to greater dimensions. In regard to the size of the cells, *Sph Schröteri* occupies exactly an intermediate position between *Glæocystis vesiculosa* and *G. gigas*; and when its large cells divide into groups of 8, they form cœnobia which are *Gl. vesiculosa* pure and simple, as figured by Nägeli, Gatt. einz. Alg., T. iv F, fig.1, the normal form of the species, and, indeed, the only one I have ever noted.

Var TETRAËDRICA, n.var. (Pl. lix, f.11).

Cellulæ intra cœnobium tetraëdrice ordinatæ.

Cœnob. diam. 44-45; cell. diam. 9-12 $\mu$ .

Sydney Water (80, 81); Coogee; Botany.

This form is not uncommon; the cells are close together, and and obviously arranged tetraëdrically.

Genus GLÆOCYSTIS Nägeli.

GLÆOCYSTIS VESICULOSA Näg. (Pl. lix., f.12).

Cœnob. diam 14-60; cell. diam. 3-6 $\mu$ .

Auburn; Collector; Sydney Water (63).

*Cf.* Nägeli, Gatt. einz. Alg., T. iv F, fig.1. He gives the cells as spherical or ellipsoid; in those specimens I have met with, the cells were always spherical.

GLÆOCYSTIS GIGAS (Kütz.) Lag. (Pl. lix, f.13, 14).

Cœnob. diam. 30-60; cell. diam, 10-20 $\mu$ .

Auburn; Collector, Murray's Lagoon; Botany (71).

Syn., *Protococcus gigas* Kütz., *Glæocapsa ampla* Kütz., *Glæocystis ampla* Rabh., *Chlorococcum gigas* (Kütz.) Grun.

GLÆOCYSTIS AUSTRALIS, n.sp. (Pl. lix., f.15).

Cœnobium globosum vel subglobosum, cellulas ovales 4, 8, 16 includens.

Cœnob. sphær. diam. 42-60, subglob. long. 20-34, lat. 15-20; cell. long. 12-18, lat. 8-12 $\mu$ .

Auburn; Guildford (23).

This species has oval cells instead of the usual spherical ones. A family of eight cœnobia, of eight cells each, was noted.

Var. *AMPLA*, n var. (Pl. lix., f. 16).

Cœnobium maximum, cellulas permultas includens.

Cœnob. diam. 145; cell. long. 10-12, lat. 6-8 $\mu$ .

Auburn. Cum priori.

A form with cœnobium much larger than usual, and enclosing a very large number of cells.

#### EXPLANATION OF PLATES LVI.-LIX.

##### Plate lvi.

Figs. 1-4.—*Carteria multifilis* (Fresen.) Dill, forma; ( $\times 660$ ).

Figs. 5-7.—*C. scrobiculata*, n.sp.; ( $\times 660$ ).

Fig. 8.—*C. scrobiculata* var. *ovalis*, n.var.; ( $\times 660$ ).

Fig. 9.—*C. australis*, n.sp.; ( $\times 1000$ ).

Fig. 10.—*C. australis* var. *orata*, n.var.; ( $\times 1000$ ).

Figs. 11, 12.—*Chlamydomonas glœocystiformis* Dill, formæ; (11)  $\times 1000$ , (12)  $\times 1330$ .

Fig. 13.—*Chl. pisiiformis* var. *attenuata*, n.var.; ( $\times 1000$ ).

Fig. 14.—*Chl. pisiiformis* var. *glœocystiformis*, n.var.; ( $\times 500$ ).

Fig. 15.—*Chl. globulosa* var. *pertusa*, n.var.; ( $\times 1000$ ).

Fig. 16.—*Chl. monadina* var. *ovalis*, n.var.; ( $\times 1000$ ).

Fig. 17.—*Chl. globosa* Snow; ( $\times 1330$ ).

Fig. 18.—*Chl. Lismorensis*, n.sp.; ( $\times 2000$ ).

Figs. 19, 20.—*Chl. Lismorensis* var. *orata*, n.var.; ( $\times 2700$ ).

Figs. 21, 22.—*Phacotus bullatus*, n.sp., (*b*) side, (*c*) end; (21)  $\times 1000$ , (22)  $\times 1330$ .

Fig. 23.—*P. bullatus* var. *conicus*, n.var.; ( $\times 1000$ ).

Figs. 24, 25.—*Pteromonas cruciata*, n.sp., (24) front, (25) side, (*a*) end; ( $\times 1000$ ).

Fig. 26.—*Pt. cruciata* var. *pulchra*, n.var., (*a*) front, (*b*) side, (*c*) end; ( $\times 1000$ ).

##### Plate lvii.

Fig. 1.—*Pediastrum tetras* var. *fluriatile*, n. var.; ( $\times 660$ ).

Fig. 2.—*P. tetras* var. *apiculatum*, n.var.; ( $\times 660$ ).

Fig. 3.—*Crucigenia tetrapedia* var. *ornata*, n.var.; ( $\times 1330$ ).

Fig. 4.—*C. triangularis* Chodat; ( $\times 660$ ).

Fig. 5.—*C. quadrata* var. *secta*, n.var.; ( $\times 1000$ ).

Fig. 6.—*Tetrastrum elegans*, n.sp.; ( $\times 1000$ ).

Fig. 7.—*T. elegans* var. *dentatum*, n.var.; ( $\times 1000$ ).

Fig. 8.—*Celastrum crenatum* var. *cubicum*, n.var.; ( $\times 660$ ).

- Fig. 9.—*C. obtusum* (Eichler) mihi, *conobium cubicum*; ( $\times 1000$ ).  
 Fig. 10.—*Selenastrum gracile* var. *minutum*, n. var.; ( $\times 1000$ ).  
 Fig. 11.—*Scenedesmus quadricauda* var. *incurvus*, n. var.; ( $\times 660$ ).  
 Figs. 12, 13.—*S. quadricauda* var. *inermis*, n. var.; ( $\times 1000$ ).  
 Fig. 14.—*S. denticulatus* var. *gracilis*, n. var.; ( $\times 1330$ ).  
 Fig. 15.—*S. denticulatus* var. *australis*, n. var.; ( $\times 660$ ).  
 Figs. 16, 17.—*S. securiformis*, n. sp.; ( $\times 1000$ ).  
 Fig. 18.—*Ankistrodesmus falcatus* var. *mirabilis* W. & G. S. West; ( $\times 660$ ).  
 Fig. 19.—*A. falcatus* var. *contortus* (Thuret) mihi; ( $\times 660$ ).  
 Fig. 20.—*A. dulcis*, n. sp.; (a)  $\times 1000$ , (b)  $\times 660$ .  
 Fig. 21.—*A. dulcis* var. *cingulum*, n. var.; ( $\times 1000$ ).  
 Fig. 22.—*A. Braunii* (Näg.), forma; ( $\times 660$ ).  
 Figs. 23–25.—*A. Braunii* var. *minutus*, n. var.; (23)  $\times 1330$ , the others  $\times 660$ .  
 Figs. 26, 27.—*Actinastrum Hantzschii* Lagerh.; ( $\times 1000$ ).  
 Figs. 28, 29.—*A. bacillare*, n. sp.; ( $\times 1000$ ).  
 Fig. 30.—*A. aciculare*, n. sp., ( $\times 500$ ); (a) single cell  $\times 1000$ .  
 Fig. 31.—*A. guttula*, n. sp.; ( $\times 1000$ ).  
 Fig. 32.—*Kirchneriella elegans*, n. sp.; ( $\times 660$ ).  
 Fig. 33.—*K. lunaris* var. *acuta*, n. var.; ( $\times 1330$ ).

## Plate lviii.

- Fig. 1.—*Oocystis crassa* var. *Ostenfeldii* Playf., forma; ( $\times 1000$ ).  
 Figs. 2, 3.—*O. crassa* var. *elongata*, n. var.; ( $\times 1000$ ).  
 Fig. 4.—*O. crassa* var. *granulosa*, n. var.; ( $\times 740$ ).  
 Fig. 5.—*O. apiculata* var. *major* Playf.; ( $\times 660$ ).  
 Fig. 6.—*Nephrocylidium Agardhianum* var. *majus* Näg.; ( $\times 400$ ).  
 Figs. 7, 8.—*N. Agardhianum* var. *planktonicum*, n. var.; ( $\times 250$ ).  
 Figs. 9, 10.—*Tetrallantos Lagerheimii* Teiling; ( $\times 1000$ ).  
 Fig. 11.—*Tetraëdron minimum* (A. Br.) Hansg; ( $\times 1330$ ).  
 Figs. 12, 13.—*Tetr. minimum* var. *australe*, n. var.; ( $\times 1000$ ).  
 Figs. 14, 15.—*Tetr. minimum* var. *pinacidium* (Reinsch) mihi; (14)  $\times 1000$ ,  
 (15)  $\times 1330$ .  
 Figs. 16, 17.—*Tetr. minimum* var. *rectilineare*, n. var.; ( $\times 1000$ ).  
 Fig. 18.—*Tetr. minimum* var. *morsum* (W. & G. S. West) mihi; ( $\times 1000$ ).  
 Fig. 19.—*Tetr. regulare* Kütz., forma; ( $\times 660$ ).  
 Fig. 20.—*Tetr. regulare* var. *papilliferum* (Schröder) mihi, forma; ( $\times 330$ ).  
 Fig. 21.—*Tetr. spinulosum* Schmidle, forma; ( $\times 1000$ ).  
 Fig. 22.—*Tetr. spinulosum* var. *excavatum*, n. var.; ( $\times 1000$ ).  
 Fig. 23.—*Tetr. hortense*, n. sp.; ( $\times 660$ ).  
 Figs. 24, 25.—*Tetr. acutum*, n. sp.; (24)  $\times 1000$ , (25)  $\times 1500$ .  
 Fig. 26.—*Tetr. acutum* var. *rectilineare*, n. var.; ( $\times 1000$ ).  
 Fig. 27.—*Tetr. hastatum* var. *elegans*, n. var.; ( $\times 660$ ).  
 Fig. 28.—*Tetr. trigonum* var. *mammillatum*, n. var.; ( $\times 1330$ ).  
 Fig. 29.—*Tetr. cruciforme*, n. sp.; ( $\times 1330$ ).

Fig. 30.—*Tetr. striatum*, n.sp.; ( $\times 660$ ).

Fig. 31.—*Tetr. Wasteneysii*, n.sp.; ( $\times 1000$ ).

Plate lix.

Figs. 1, 2.—*Richteriella botryoides* (Schmidle) Lemm.; (1)  $\times 1000$ , (2)  $\times 660$ .

Figs 3, 4.—*Bernardia Chodati* (Bernard) mihi: (3)  $\times 660$ , (4)  $\times 1000$ .

Figs. 5, 6.—*B. Chodati* var. *cruciata*, n. var.; ( $\times 660$ ).

Fig. 7.—*B. Wratislavensis* (Schröder) mihi; ( $\times 1000$ ).

Fig. 8.—*Tetracoccus botryoides* West; ( $\times 500$ ).

Fig. 9.—*T. botryoides*, tetrads of cells radiating from a common centre; ( $\times 200$ ).

Fig. 10.—*Sphvrocystis Schröteri* Chodat; ( $\times 500$ ).

Fig. 11.—*S. Schröteri* var. *tetraëdrica*, n. var.; ( $\times 500$ ).

Fig. 12.—*Glaucocystis vesiculosa* Näg.; ( $\times 660$ ).

Figs. 13, 14.—*G. gigas* (Kütz.) Lagerh.; ( $\times 250$ ).

Fig. 15.—*G. australis*, n. sp.; ( $\times 500$ ).

Fig. 16.—*G. australis* var. *ampla*, n. var.; ( $\times 250$ ).

Fig. 17.—*Tetraëdron regulare* var. *inermis*, n. var.; ( $\times 1330$ ).

Fig. 18.—*Carteria scrobiculata*, n.sp., end-view; ( $\times 660$ ).